Champagne on ice for SBM’s first launch of Generation 3 FPSO

New, all-in-one, state-of-the-art installer

Fizzle out flaring on FPSOs

New SBM technology wins OTC 2013 award

One-Stop-Shop at SBM for Semi-submersible and Tension Leg Platform technology

Extending the operating envelope of large mooring systems

On the cover: FPSO Cidade de Paraty.

We want to hear from you: If you have comments about any of the articles in this issue or any ideas for future issues, send them to currents@sbmoffshore.com.

Currents is issued by the Group Communications Department.
Welcome to the latest issue of SBM Offshore’s company magazine. We are happy to share our stories and achievements with our clients and stakeholders as well as visitors to our booth at the OTC conference in Houston this month.

Firstly, I would like to thank the jury of the OTC Spotlight on Technology for honouring SBM Offshore with one of the awards. This prestigious accolade endorses our position as a key technology leader in the offshore service provider sector. It also gives our engineers the independent praise that makes them proud of their successes and gives them the motivation to continue innovating to meet the evolving needs of the industry.

It’s been a busy few months. We made the news with the award by Petrobras for a double FPSO order for operation in the pre-salt province offshore Brazil. This significant project is a record breaker for the company, the FPSOs are amongst the largest ever built by SBM Offshore and along with Cidade de Paraty and Ilhabela represent the successful launch of our new Generation 3 FPSOs, building on our trusted performance and unrivalled uptime.

Enjoy this month’s issue.
Champagne on ice for SBM’s first launch of Generation 3 FPSO
Things are definitely buzzing right now on the Brazilian front for SBM Offshore. The company has in hand no fewer than four of the most complex FPSO projects yet seen by the oil and gas industry anywhere in the world. All of these billion dollar plus floating production vessels are set to help develop the country’s huge deepwater fields in the prolific pre-salt Santos basin.

Start-up of the first of them - Cidade de Paraty – is imminent. This high capacity vessel was towed out on 16 April to the Lula Nordeste field from its final integration base at the Brasfels yard in Angra dos Reis. “Now we have two more milestones to achieve before the end of July,” says SBM’s Project Manager Peter de Haas.

“With the 28-hour tow to location completed, we will hook up the 24-line mooring system and risers on a schedule to achieve first oil by the end of May,” he says. “Then we will stop flaring the associated gas once we get the compression systems up and running.

While all this is going on for Paraty, elsewhere in the world the second of SBM’s quartet of leading-edge FPSOs is taking shape at yards in China and Brazil, where hull conversion and topsides construction respectively are taking place.

This is Cidade de Ilhabela - with a processing capacity 25% higher than Paraty’s 120,000 bpd, and the largest FPSO the company will have ever built. As Project Manager Alex Brigden points out, it is also the company’s most global project, with project management centred around a team in Schiedam in the Netherlands.

And as if this pair was not enough, in March Petrobras confirmed a $3.5 billion fast-track follow-on order to SBM. This was for two more floating production units of the same scale as FPSO Cidade de Ilhabela. The units - known as Alpha and Beta - are destined for the Lula Alto and Lula Central locations and need to be pushed ahead at an unprecedentedly fast pace to perform their roles in Petrobras’ grand plan for the pre-salt region.

The order from Petrobras forAlpha and Beta is the largest order ever won by SBM Offshore. It will keep the company and its contractors and suppliers fully occupied until deliveries at the end of 2015 and early 2016 respectively.

The only way such a target can be achieved is for SBM to build the new vessels as “carbon-copies” of Ilhabela, squeezing every last advantage out of that cloning process to improve efficiency and save time.

SBM’s huge programme of work for Petrobras has also sparked several other major initiatives. The first of these is the Brasa yard.

As far back as 2011 the company embarked on a plan to set up a construction yard in Brazil that it could call its own and be sure its projects would get top priority. In today’s overheated construction climate in the country there is the constant danger of being overshadowed in a yard that is also building for other clients.

The Brasa yard also provides a hugely valuable local content aspect and undoubtedly helped clinch the Alpha/Beta contract.

A further initiative by SBM Offshore is a shift in emphasis to China for conversion of the tanker hulls which provide the basis of the oil and gas processing and storage units that are leased and operated by SBM.

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**FPSO Cidade de Paraty**

Location: BM-S-11 block, Lula Nordeste Field, Partners in Block: Petrobras Netherlands B.V. 65.0%, BG Group 25.0%, GALP 10.0%. Lease & Operating Consortium: Queiroz Galvão Óleo e Gás 20.0%, SBM Offshore 50.5%, Nippon Yusen Kabushiki Kaisha Group 17.5%, Itochu Group 12.0%.

**FPSO Cidade de Ilhabela**

Location: BM-S-9 block – Sapinhoá Field, Partners in Block - Petrobras (45%), BG E&P BRASIL LTDA (30%) and REPSOL YPF BRASIL S.A. (25%), FPSOs will be owned and operated by a Joint Venture company owned by SBM Offshore with other partners including Queiroz Galvão Óleo e Gás S.A.(QGOG).

**FPSOs Alpha & Beta**

Location: BM-S-11 Block, Lula Field, Partners in Block: PETROBRAS (65%), BG E&P Brasil Ltda. (25%), and Petrogal Brasil S.A.(10%). FPSOs will be owned and operated by a Joint Venture company owned by SBM Offshore with other partners including Queiroz Galvão Óleo e Gás S.A.(QGOG).
Also, for the first time in its history, SBM is moving to conversion of a pair of double-hulled VLCC tankers for Alpha/Beta, instead of the single-hulled tankers which have been its feedstock until now.

Back in The Netherlands, SBM’s office in Schiedam is at the heart of these Generation 3 projects for Brazil. “We are carrying two and a half projects - Paraty, Ilhabela and half the scope for Alpha/Beta,” says Yves Paletta, Managing Director of SBM Schiedam. The Alpha/Beta project is executed jointly with the SBM Offshore Execution Centre in Monaco.

“It’s a major transformation and to deliver these complex projects we’re making sure we are learning as fast as we can from Paraty and embedding the learnings into Ilhabela and Alpha/Beta in terms of efficiency, safety and local content. We are going for a schedule of 31-33 months for Alpha/Beta,” he says, “which is an extraordinary achievement made possible thanks to the carbon copy effect with Cidade de Ilhabela.”

Schiedam comes from an engineering background rather than EPC roots, so along with Operations Director John Schubert, Paletta is looking to “transform the company to become a world-class EPC entity.

“You end up with a lot of void spaces that have to be actively maintained and larger transverse spans which are more complex for supporting modules. Also they generally have a lot more high tensile steel. Although this does not affect overall strength, fatigue life gets used up more rapidly, so you have to do more to counter that.”

Double-hull carriers are also a little larger than their single-hull equivalents, so the mooring systems on Alpha/Beta will need modification compared with Ilhabela. And the extra deck space will not be of as much value as it might have been if Ilhabela’s topside design were not being cloned for the new units.

Brazilian operations

As well as building its new fleet of Generation 3 vessels for Brazil, SBM is charged with operating them in the field for their full production life.

This is the responsibility of its fleet operating company SBM Production Contractors (PC), where Mike Wyllie is currently acting as Managing Director.

Describing the biggest challenges for PC he says: “a lot of the move to the ‘Generation 3’ FPSOs that we have for the Santos basin, is from a conversion point of view, double-hulled tankers don’t offer many helpful advantages and definitely represent an increase in the challenge compared with older mild steel single-hull tankers.”
around upping our game to be ready to man up all these new units with competent people. With 80% of the crew required to be Brazilian from day one we need to hire a lot of Brazilians and we’re looking at things like strengthening our training facilities in the country."

There will also be geographical implications. “We opened our new shorebase office in Santos in mid-April,” says Wyllie. With the start-up of Paraty this will begin life as a satellite of SBM PC’s headquarters for Brazilian operations, in Macaé.

Next year, as Ilhabela starts up, the Santos office will double in size. “Later, when you add Alpha/Beta”, says Wyllie, “the whole centre of gravity of our operations in Brazil will move there from Macaé.

“We will be operating the four biggest vessels in our fleet, all side-by-side, all out of Santos,” he points out. “That’s nearly 600,000 bpd of production capacity and a very significant daily revenue coming through that office.”

A first for SBM in China

For Ilhabela, SBM has struck up a new relationship in China. It has chosen the Chengxi shipyard in Guangzhou to convert the hull. “This is the first time we’ve taken an FPSO to China,” says Ilhabela Project Manager Alex Brigden.

The relationship has been shaping up well, and has expanded more quickly than originally planned. “There is a very open style from the management,” says Brigden.

“We put in a large team to support the yard and bring them up to speed and we can see parallels from when we first started with Keppel in Singapore,” he continues. “They are going to be a good asset for us in the future.”

He cites an excellent example from the very start of the Ilhabela conversion. When the conversion vessel arrived in China and was given its close-up survey, it was clear that the level of corrosion in the upper deck called for substantial replacement work.

“Our contractor is a repair yard in the CSSC group - China’s largest shipbuilder and the second largest in the world,” says Brigden. "Nearby the group has a newbuild yard as well.

“So we seized the opportunity to have the upper deck replacement done as newbuild. We did the same with the accommodation because it didn’t quite meet Brazilian regulations.

“"It was our good fortune to have selected a conversion yard that was part of this bigger group”, he continues. "Now this has become a theme for Alpha/Beta: that we make use of both yards and their skillsets, with some new building and some ship conversion. So what we are actually producing is an FPSO as a hybrid, and this is new for SBM.”

The converted Ilhabela hull will leave for Brazil in the middle of 2013.

The Chinese yard has also achieved an admirable safety record of more than five million manhours so far without a lost time incident. This is
comparable with world norms and an excellent achievement.

“It is difficult because the yard had not worked under offshore safety standards before, and had not had that many international customers,” says Brigden, “but they improve progressively, week on week.”

Brazil’s new yard

In little more than a year, SBM has set up a fabrication yard in Niteroi, just across the Bay from downtown Rio, dedicated to the company’s own needs.

Undoubtedly the Brasa yard was a significant factor in helping win the coveted Alpha/Beta contract.

“Without Brasa we wouldn’t have been in a position to win,” says Philippe Levy, who is acting General Manager of the yard in addition to his role as head of SBM Brazil’s office in Rio. “Petrobras gave us the award because we had more capacity for local content.”

Developed in 50:50 partnership with Brazil’s Synergy group, the yard has been created from a derelict yard that stood empty 18 months ago. “We aim to be seen as a yard that delivers on time,” says Levy. “It’s the mark of SBM and we want to build on this reputation.”

The first project for Brasa is Ilhabela: “the yard has been up and running since July last year” says Project Manager Alex Brigden, “and it is building ten modules weighing a total of about 12,000 tonnes”. Over 1000 employees are there now and that will rise to 2000 people in the coming months.

Immediately once module construction work for Ilhabela is finished, Brasa will go straight into fabrication of ten of the 18 modules required for Alpha/Beta, starting next year and running to the end of 2015.

“Our intention, at least initially, was to use a high proportion of sub-contractors for work in the yard and move to a growing proportion of direct employees,” says Brigden. “That process is going well, and we are finding that the productivity of employees under direct management is excellent, which is a very positive development.”

The Rio area, and especially Niteroi has a good pool of well-trained labour to choose from, he points out. “And it is important to emphasise that as well as competitive salaries, Brasa also offers long-term prospects, with Ilhabela and other projects coming through.”

Paraty leads the way

As first of the far more complex ‘Generation 3’ breed of FPSO being built by SBM in Brazil, Cidade de Paraty is pioneering the path now being followed by Ilhabela and Alpha/Beta. Although those three later units will not be clones of Paraty, they will benefit greatly from the lessons learned there.

Summarising the Paraty story, Project Manager Peter de Haas speaks of an aggressive start to the project, pushing engineering and procurement to gain as much float-time as possible in the 36-month overall schedule. This was followed by a period of force majeure delays and setbacks during the fabrication work in Brazil which eliminated much of that float time.

After a joint alignment meeting with Petrobras, BrASFels and SBM Offshore the pace picked up steadily, finishing in a highly satisfying push to achieve the sail-away date on 16th April.

“By very thorough preparation of the integration phase - from the moment the last topside module was placed on the vessel, to the moment it could leave the quayside - we have managed to complete that work in five and a
half months,” says de Haas. “Even in an experienced Singapore yard that would be quite an effort,” he remarks. “It was certainly challenging, but very rewarding.”

“It is quite a jump to Generation 3,” says de Haas. “Paraty really is the most complex unit delivered by SBM to date”. As well as vessel size, “the complexity comes in the gas conditioning and compression systems,” he points out. “It is the first time where we remove CO2 with membrane technology, and the first where we do deep dehydration of gas - removing the water with molecular sieves. Also, we provide gas and CO2 compression up to 550 bar - at the forefront of the industry.”

Module construction started in March 2011, sixteen months before the hull arrived from its conversion by Keppel in Singapore. There were 15 topsides modules, weighing a total of 12,500 tonnes, with twelve of them built in Brazil - six by Brasfels, four by EBSE, and two by Enaval.

“The difficulty here in Brazil,” says de Haas, “with so much work being pushed into this country, there are tremendous constraints on resources, especially skilled manpower.” In addition, there were three weeks of strikes at two of the sites in May last year.

Among the very positive surprises for SBM was the lifting campaign to place modules on the vessel at Brasfels. “With these complex, congested units we have a struggle for plot space,” says de Haas. “Yet all twelve heavy lifts went very smoothly, without any significant clashes.”

A major requirement, successfully met on the Paraty project has been to achieve the required 65% value of Brazilian content. “We have taken this seriously from day one and even exceeded this target to reach 68%,” says de Haas.

“It is very important to staff up with Brazilian nationals and to have a good presence in country. We have also put quite some energy into adjusting our designs in order to buy Brazilian.”

It was certainly a very fruitful strategy by SBM to establish an office in Rio - headed by General Manager Philippe Levy as local content champion and key client contact. This has evolved to provide a really strong supporting function to the company’s projects in Brazil. It deals with everything from vital topics like logistics and customs clearance to local transport and accommodation.

As for the challenge of coordinating a global project like Paraty, de Haas reflects: “the key is to establish personal contacts between key individuals at all sites”.

He underlines the value of the SBM company slogan “work as one”, introduced when Chief Executive Officer Bruno Chabas came on board early last year. “That slogan really works,” he says. “It is definitely improving results, and it is also instilling a nice working atmosphere.”

Among the lessons of Paraty passed on to Ilhabela an important one concerns materials handling on a big congested topside and the scope for optimising layout and ergonomics to improve that.

As for the vessel’s readiness at its mid-April sail-away, SBM Schiedam’s Operations Director John Schubert remarks that “we had considerable carryover work due to delays in engineering and then equipment delivery; however, by the time of her departure we had achieved a good balance with a client happy to have the vessel offshore to start hook-up of moorings and risers.”

 FPSO Cidade de Paraty at quay side at Brasfels
New, all-in-one, state-of-the-art installer

What’s better than one state-of-the-art installer? Quite simply ‘two’.

Towards the end of this year SBM Offshore will add another high-tech vessel to its installation fleet, giving SBM Offshore a reason to be proud and clients a reason to be content that she will be up and ready for service.

The newly built SBM Installer (SI) will raise the bar in higher standards for the new generation of Dive Support & Construction vessels. Her design was in response to a call from clients for increased versatility in capacity and a ‘do-it-all’ vessel in order to eliminate the need for separate elements such as a diving support and a crane, which normally have to accompany an installer. SBM engineers drew on 40 years of experience in offshore installation, diving works and construction activities worldwide in all kind of water depths. The construction of the installer is currently taking place in the Keppel Singmarine in Singapore.

What differentiates the SI from the competition is her exclusive combination of a fully integrated saturation diving system with strong construction and chain handling capabilities in a Dynamic Positioning (DP) class III vessel - with the higher class of redundancy - giving her unrivalled versatility and efficiency within a safe working environment.

The key components

The 111-metre vessel is equipped to carry out offshore construction and installation work in water depth of up to 1,700 metres with a 275t SWL (Safe Working Load) knuckle boom crane and an active heave compensated 150t SWL winch. To handle and store safely long lengths of mooring legs, she is also equipped with a 200t SWL double-drum winch and four large storage areas called chain lockers of 135m³ each.

The patented double-deck concept, already tested and proven on the Normand Installer, provides a large storage and construction area on the upper deck while keeping the conventional main deck unobstructed to run chains or wires over the stern under tension. Arnaud Annebicque, Operations Manager of the Normand Installer, says that clients are unanimous in their comments “The double deck concept brings a real plus, SBM made a smart design, which is well fitted to deep water construction works.”

Two types of diving systems are possible depending on the water depth. Up to 50m, a conventional air diving system is operated over the starboard side of the vessel. For deeper diving operations, a saturation diving system allows work up to 300m. The deep water diving is a very specific and constrained activity. The divers stay confined in the pressurised

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The SBM Installer has reached **2.4 million man hours** during the construction phase without a Lost Time Incident

Three living chambers saturation diving system
atmosphere during the entire diving campaign up to 28 days, plus a decompression phase that can take 10 to 12 days depending on the depth and pressure.

The SBM Installer system has a 12-man capacity, even if one of the three chambers is undergoing maintenance. Each chamber can be pressurised independently allowing several teams to work at different water depths.

In case of emergency a specific hyperbaric lifeboat will safely evacuate the divers, while maintaining the pressurised environment.

Operations will be supported by two heavy work-class Remotely Operated Vehicles (ROVs). Both ROVs can carry out observation and intervention works to a water depth of 3,000m.

Safety, versatility and redundancy are the three key concepts to have driven the design of SBM Offshore installation vessels.

The double-deck concept allows preparation for future operations while deploying the subsea equipment. However, this benefit can mostly be quantified in terms of Safety, with an excellent safety record clocked up on the Normand Installer as proof. Of note is the firing line located on the lower deck where no personnel are allowed during subsea deployment operations.

The vessel’s many advantages: being an Anchor Handling Vessel (AHV), a Diving Support Vessel (DSV), a construction vessel, and a large deck (thanks to the flat upper deck to easily store, mobilise, and demobilise all kind of equipment) gives the vessel great versatility. The combination of all these features means she can perform complex and diversified tasks eliminating the need to mobilise other vessels. The two cranes can be used to place equipment overboard, to install, then transfer the load to one of the deepwater winches. The heave compensated winche is utilised if slow motion is required during landing phase; or the double drums winch is used if the landing speed is not that critical for the operation in hand.

Finally, redundancy of equipment is fundamental to both keeping the vessel operational in the case of equipment failure but also in allowing the combination of functions to save time and increase efficiency.

Two years following contract signature, the vessel is now nearing completion and the phase of heavy testing and commissioning – including sea trials – is currently taking place. Once delivery takes place in Singapore this summer, the SI is scheduled to start working on projects in Q4 2013.

Her first area of operation will be West Africa, where SBM Offshore operates six FPSOs. Then the world is her oyster. Her transit speed and reduced consumption will optimise her fast redeployment all over the world, including Brazil, North Sea, Middle East, South East Asia and the Gulf of Mexico.

The SBM Installer will install offshore Angola the FPSO N’Goma, the former FPSO Xikomba. This life extension project was managed by the Kuala Lumpur execution centre in liaison with the PAENAL yard. The fabrication and integration yard is in charge of two process modules - a clear example of the seamless interface full life cycle service provided by SBM Offshore.

Versatility, redundancy and safety achieving an increase in efficiency are the main benefits of the SBM Installer: these enable her to outpace all other vessels in her category and allow in most cases for the mobilisation of only one vessel rather than several to execute the complete scope of work.
What if tomorrow gas flaring was even more restricted? Anticipating this scenario SBM Offshore teamed up with Compact GTL and following four years of collaborative design and engineering development, the two companies have come up with a unique solution for FPSOs, exclusive to SBM Offshore, which could change the way oil and gas companies view new offshore field developments.

With oil field discoveries increasingly located in remote and deep waters the problem of associated gas disposal has become an expensive and tricky dilemma for the big players in the industry. Using pipelines to market is prohibitively costly for stranded fields where there is no infrastructure. Other alternatives include electricity generation or gas re-injection into the reservoir or flaring, which is becoming increasingly off limits in some parts of the world, even in temporary settings such as for Early Well Test (EWT) work. The industry is calling for oil operators to reduce flaring by natural gas associated with oil production by a further 30% by 2017 – equivalent to taking 60 million cars off the road.

A viable, industry approved, solution to eliminate flaring is offered by UK-based company CompactGTL who have designed an adaptation of conventional Gas to Liquid (GTL) technology for smaller scale applications, to accommodate operations where a small volume of gas is produced.

Foreseeing the potential to adapting this pioneering technology for specific use on SBM Offshore’s FPSOs, the company signed an exclusive commercial agreement late last year with CompactGTL to collaborate exclusively on offshore projects. Together we are advancing the GTL technology in tandem to further develop the technological edge of our FPSOs. A commercial demonstration plant (Figure 1) provided by CompactGTL has been in operation onshore in Brazil since December 2010, funded by Petrobras, further validating the importance of this technology.

**Mini-size GTL plants**

Conventional GTL plants are known to be very large structures, the Pearl GTL project in Qatar is said to be the size of 450 football fields, but now SBM Offshore with our partner propose a new smaller scale solution, enabling the GTL plant to fit on an SBM Offshore FPSO vessel.
This agreement with CompactGTL – represents a world-first for such vessels. Mike Wyllie, Chief Technology Officer at SBM says “CompactGTL has brought the technology to a point where we believe it can be integrated relatively easily on to an FPSO. From our viewpoint we are looking actively at a number of ways of increasing the complexity of converted FPSOs. We target the top-end of the market and GTL is one way of extending our capability into more complex units. We’re starting small, using it for associated gas disposal – we think that’s a good way to get it offshore and gain experience in operating a floating facility with GTL capabilities.”

What are the benefits of GTL to FPSO users?

For offshore solutions the gas to liquid technology solves the problem of the associated gas – the offshoot of oil production – whilst creating additional synthetic crude revenues for the operator. This represents a significant benefit by turning what was originally a liability into an asset and at the same time eliminating the need for flaring. Deploying a GTL plant on the deck of an FPSO represents a paradigm shift; first hand it becomes a project enabler, allowing oil companies to proceed with field development, where previously it was not commercially viable. According to Iain Baxter, Director of Business Development at CompactGTL “with small-scale GTL, because the end product is synthetic oil which can be easily mingled with the conventional crude oil, the oil company has a single, easily accessible market for the product, requiring no separate storage or transportation, irrespective of the oilfield location.”

Bottom line for oil operators is that the new technology incorporated to an FPSO increases the productivity whilst addressing the legislative issue of flaring. CompactGTL Chairman, Tony Hayward, says “CompactGTL is the clear leader in a currently untapped sector of the oil and gas industry, helping to change the perception of GTL through providing a game-changing, economically viable solution to the global problem of gas flaring.”

It is a logical step for the two companies, both leaders in their respective fields, having successfully worked together since 2008. By consolidating their respective strengths and expertise for the marketing and execution of projects involving associated gas challenges for offshore oil fields they represent a powerful duo in the expansion of the sector. The optimised FPSO with an integrated GTL plant can be applied to an EWT service or on a full field development. Michael Wyllie explains “in an EWT context, this technology is perfect. You can hop from field to field without flaring gas. We have done extensive studies in-house for such a vessel. Now the next step is to go into FEED study with a client for a specific application in either an EWT or full field development context.”

With an exclusive agreement in place SBM Offshore, the leader in the supply of leased FPSOs, increases its competitive advantage by offering the world’s only floating production system with a fully integrated, modular GTL solution allowing for a capacity of 25MMscf/d, up to 32,000 bbl/d crude production and 2,000 bbl/d GTL liquids production. Mike Wyllie, comments “SBM Offshore and CompactGTL provide complimentary expertise, and by combining this we have been able to develop an exciting new FPSO product, which will be a very attractive solution for associated gas disposal in ultra deepwater fields”. 

Nicholas Gay, Chief Executive, CompactGTL said: “CompactGTL is delighted that we have been able to cement our longstanding relationship with SBM Offshore. It is a world class company and, combined with our expertise in delivering the world’s first commercial scale modular gas to liquids solution for associated gas, will have significant impact on the offshore oilfield appraisal and development sector.”

Figure 1

Artist’s impression of the riser balcony

CompactGTL
The modular gas solution

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SBM Offshore is delighted its endeavors to step up the pace of technology have resulted in stepping up to the podium.

During the annual Offshore Technology Conference (OTC) this month in Houston, SBM Offshore will join the line-up of proud winners for the prestigious ‘Spotlight on New Technology’ award. The company’s innovative product, the Drilling Riser Trip Saver™ is among 15 technologies to be recognised – having fulfilled the jury’s overall requirement ‘to provide significant impact for offshore exploration and production.’

Using a rail-mounted transport system, which relocates a suspended drilling riser with a drilling riser tensioner system and surface blowout preventer in-place, the Drilling Riser Trip Saver™ is an innovative apparatus and method for drilling multiple subsea wells consecutively, while saving time, money and reducing risk by avoiding removal of the suspended drilling riser from the well bay.

The SBM Offshore dedicated team in Houston contributed to the technology’s design development and Randy Jordan, Vice President Floating Production Systems, who is attending OTC to meet with industry players, developed the conceptual design.

Last month when the winners were announced 2013 OTC chairperson Steve Balint congratulated winners on their achievements "The innovation shown by this year’s Spotlight Award recipients demonstrates the type of ingenuity and forward thinking that is advancing the industry to new levels of safety, productivity, and efficiency."

Winning technologies were selected based on the following five criteria:

1. New: less than 2 years old
2. Innovative: original, groundbreaking, and capable of revolutionising the offshore E&P industry
3. Proven: through full-scale application or successful prototype testing
4. Broad Interest: broad appeal for the industry
5. Significant Impact: provides significant benefits beyond existing technologies
The grain of the idea for the Trip-Saver™ system was planted in mid-2011 and inspiration was fostered playing around with feedback from clients’ inefficiencies and delays occurring during their operations. This led the team on the inventive road to the technology’s development and it was first introduced in April 2012 in a client bid request for a dry-tree Tension Leg Wellhead Platform (TLWP) application in West Africa in 800 metres water depth.

This method of handling and transferring a high pressure drilling riser from one well to another on a dry-tree TLWP has not been previously developed. This meets the most important of the award’s five criteria that the technology be innovative and capable of revolutionising the offshore E&P industry. The Drilling Riser Trip-Saver™ represents a substantial time savings during the drilling campaign by alleviating the need to recover and redeploy the drilling riser multiple times as well as substantially reducing the wear and tear to the drilling riser, thus saving money as well. Additionally and most importantly, it results in reduced safety risk by minimising dropped object hazard concerns during simultaneous drilling & production operations while live wells are in production.

As with all new technology concepts, their success is judged by the ideas in action and if they actually work. The technology behind the Drilling Riser Trip-Saver™ has been proven based on a full scale test of similar technology developed and currently in use on three deep water semisubmersible drilling units subsea BOP Handling systems.

It is not the first time SBM Offshore has received this prestigious award – previous winning innovations are:

**Electrical Swivel – 2011**

**Cool Hose – 2011**

**LNG Toroidal Swivel – 2007**

Mike Wyllie, Chief Technology Officer congratulated the team on this year’s win saying “it clearly shows the valuable contribution that SBM makes to the industry as a Technology Leader.”

The Drilling Riser Trip-Saver™ has generated a great deal of interest due to the advantages it offers. Randy Jordan, Vice President Floating Production Systems, is in discussion with several potential clients who are interested in adopting it to improve their operations. “We are delighted with the Spotlight award, which will further increase the level of interest in our product,” he says.

One of SBM Offshore’s clients commented “when conducting simultaneous drilling and production operations our companies HSE policy mandates that any equipment lifts in excess of 15mt require shut-in of live producing wells due to dropped object hazards within or above the well bay, this system removes the dropped object risk by alleviating the need to recover and re-deploy the drilling riser in close proximity to live producing wells in addition to the associated production downtime due to well shut-in & startup concerns associated with well fluids cool down and production start-up complications that occur after cool-down.”

Summed up the Drilling Riser Trip-Saver™ diminishes most of the negatives previously experienced by operators offering reduced drilling cycle time, reduced maintenance to drilling systems, reduced dropped object hazard, reduced safety risk resulting in reduced shut-in and start-up of producing wells, simultaneous drilling and production operations with reduced risk.

The Spotlight on New Technology Awards, which are for OTC exhibitors, showcase the latest and most advanced hardware and software technologies that are leading the industry into the future. Speaking of this year’s winners Spotlight Award Committee Chair Helge Hove Haldorsen said “It is thanks to them that offshore E&P will continue to play a key role in supplying the world with affordable energy in a sustainable manner.” It sums up SBM Offshore’s ethos.

SBM Offshore and the other winners are honoured in a special multi-page section of the OTC conference program. The award will be presented on 6th May in the Rotunda area outside of Exhibit Hall B in the Reliant Center during the conference.

This ground-breaking technology will have broad appeal for the industry thanks to the time and cost reduction achieved while drilling multiple wells from a single site, particularly when compared to current technology, which requires the drilling riser to be recovered and redeployed multiple times.
One-Stop-Shop at SBM for Semi-submersible and Tension Leg Platform technology
A t SBM Offshore, we rise to the challenges and strive towards our goal of fast becoming the trusted partner of choice in the development of complete offshore floating solutions for the world’s energy companies. Our competence in FPSOs is well-known however our expertise also covers other needs. Not all situations are perfectly adapted to an FPSO vessel and contracting a drilling MODU is often an expensive option, hence why we offer several diverse solutions. Our Group has a product portfolio that can offer a range of other floating production options developed using our in-house engineering, procurement and project management capabilities.

Certain systems need to accommodate specific weather conditions and harsh environments for operations. In addition, major players are exploring deeper and more remote waters – sometimes 200 or more miles offshore - where no export pipeline infrastructure exists. With so many factors involved in the decision to develop a field it can feel like an obstacle course to clients when choosing the right strategy to move forward in an efficient and economical manner. For some fields a combination of either a TLP or a semi-submersible in combination with an FPSO is the ideal solution as the FPSO can be anchored nearby a dry tree wellhead unit for processing and storage purposes. We are seeing this option now being used in West Africa and in Brazil.

Elements to be considered include whether the field has short-term or long term potential, full-field or phased development, flow assurance and export mode (pipeline or shuttle-tankers) and as mentioned weather conditions. The beauty about SBM Offshore is that we offer all-encompassing solutions. Clients can turn to SBM for a fully integrated combined solution of wellhead unit and FPSO eliminating the complex interfaces to be managed between the two floating installations.

Semi-submersible technology

In the early 1970’s, semi-submersibles began to be used as floating production platforms for production from subsea wells. However, the weakness in these early systems was the available riser systems to produce oil and gas from subsea wells, as well as for oil and gas export. Early systems first used top-tensioned risers, which then evolved into flexible catenary riser systems. Then, in the 1990’s, the first steel catenary riser (SCR) system was installed from a TLP, providing a much cheaper and generally more robust riser system than flexible pipe, but one which was more sensitive to vessel motions. For a number of years, semisubmersible production platforms continued to be developed with flexible risers because of the larger motions inherent in these platforms.

\[\text{The Thunder Hawk FPU was one of the first to address the new Gulf of Mexico environmental criteria which evolved from the Ivan, Katrina and Rita hurricane experiences}\]

With the big players in the industry having to explore deeper and more difficult waters, the race was on to find a solution to accommodate their evolving needs. Focusing on wave motion response characteristics, SBM Offshore’s engineering team in Houston developed the new generation semi-submersible capable of supporting the use of SCRs in deep water applications. Called the DeepDraft Semi®, this inherently safe design with its robust hull has has quickly gained wide acceptance in the industry. We hold the record for the deepest water depth semi-submersible Floating Production Unit (FPU) in the world: Independence Hub, which was installed in 2007 at a depth of 2,469 metres in MC 920 in the Gulf of Mexico (GoM) for Enterprise Products Partners. This facility set many industry firsts in engineering design and construction, and is equipped to process gas from ten fields with excess payload capacity to handle an additional ten fields. Another example of SBM’s excellent track record for this type of semi-submersible FPU is the Thunder Hawk, another DeepDraftSemi® which is owned by SBM and leased to Murphy Oil. Thunder Hawk is also operating in the harsh hurricane conditions of the GoM at a water depth of 1,847m. First oil was achieved in July 2009, and it is equipped to process both oil and gas from the Thunder Hawk field. The project’s scope included providing full Engineering, Procurement, Construction and Installation (EPCI) services for the Topsides, Hull,
Moorings, Installation and offshore commissioning. SBM Houston also provided the detailed steel catenary riser (SCR) design and helped develop the wave slam load methodologies utilized in this project.

A key feature of the DeepDraftSemi® is its low motion characteristics to accommodate the requirements of SCR risers in a cost-effective manner compared to other FPU concepts. Another significant advantage is the system’s ability to mate the topsides deck to the hull at quayside, avoiding costly offshore lifting and system commissioning operations. By integrating the topsides on to the hull at quayside, the FPU can be fully pre-commissioned and USCG ‘Quarters Habitable’ permits can be obtained prior to mobilising the facility offshore – so reducing costly, labor intensive, offshore commissioning activities.

The DeepDraft Dry-Tree Semi is a logical extension of the DeepDraftSemi®. The DeepDraft Dry-Tree Semi-submersible co-locates the drilling activities and wellhead or production activities on the same vessel. The semi-submersible maintains its advantages of being a desirable riser support platform, enables quayside integration and quayside commissioning. Significant design effort is complete for the more benign locations such as off the coast of West Africa and Brazil. Model tests provide SBM with a wealth of information which is used to understand and to improve on their design approach for the more extreme environments. Presently, SBM is performing a series of DeepDraft Dry-Tree semi-submersible model tests at Laboceano in Rio de Janeiro, Brazil. The model test program is focused around a dry tree units located in 2,440 metres of water and exposed to wave conditions ranging from benign to extreme hurricanes. Riser stroke and the effect of the riser guide on the motions are some of the key performance characteristics to be analysed.

**Tension Leg Platforms (TLPs)**

SBM’s product line includes the TLP products SeaStar®, FourStar® and FourStar XC. The TLP product line provides wet and dry tree solutions up to water depths of 1,500 to 1,800 metres for hurricane and non-hurricane environments. SBM designed, built, and installed the first mini-TLP, the first EPC contractor provided TLP, and the first subsea completion TLP.

SBM’s experience in TLPs includes development of the SeaStar mono-column mini-TLP, with 5 installed examples in the GoM from 1998 through 2007 in water depths up to 1,300m. These are all small platforms, with payloads (equipment, deck structure, risers) of 4000 to 12,000 tonnes. For larger payloads, and for installations in areas without the infrastructure available in GoM, SBM has developed several 4 column TLP configurations which can be scaled up to payloads of 40,000 tonnes, and are self-stable for transport and installation with all equipment installed and commissioned at quayside.

A key advantage of the TLP is that the large vertical heave motion is eliminated resulting in short stroke top tensioned riser systems which gives substantial cost reductions for these systems versus laterally moored floating production systems such as Spars. As a result TLPs provide an ideal support for risers of all types. Another key advantage is the cost savings related to drilling and production hardware and operating cost versus wet tree subsea drilling & production hardware cost. Dry-Tree TLP’s equipped with Tender Assisted Drilling capability or Self Contained Drilling modules allow for the drilling, work-over and well intervention activities to be performed directly from the TLP to multiple subsea wells from onboard the TLP versus long term contracting of a Mobile Offshore Drilling Unit (MODU) required to perform drilling, completions, well intervention and work-over activities required for subsea completions. A Dry-Tree TLP achieves this drilling and completion advantage by utilizing high pressure Top Tensioned Drilling & Production Risers connected directly to each of the subsea wellheads and extending up to the TLP lower production deck, the riser is supported by the deck mounted production riser tensioning systems. The wells are drilled and cased individually through a high pressure drilling riser with a surface blowout preventer (BOP), the well is then secured to allow disconnection of the drilling riser in order to install the high pressure production riser. Once the production riser is installed the well can then be vertically accessed in order to install the production tubing supported by the subsea wellhead and surface wellhead installed directly onto the upper end of the production riser tension joint which can then accept the surface production tree. The production flow-line and annulus high pressure flexible jumpers are then installed along with the surface tree control umbilical.

Another advantage is the TLP’s small footprint, which allows it to be used in conjunction with other moored systems in close proximity such as an FPSO or FSO connected
by catenary flow-lines or SBM’s GAP subsea pipeline system. In this field development scenario the Tension Leg Platform is utilised as the wellhead platform hence the term Tension Leg Wellhead Platform (TLWP) as the processing of the produced fluid occurs on the FPSO when storage and offloading is preferred to export to pipelines.

SBM’s development of the FourStar® TLP and FourStar XC TLP was based on experience with both the SeaStar®, and the DeepDraft Semi®. The objective was to provide an improvement over the traditional round column TLP, while incorporating lessons learned from our other projects. The new platforms were to be simple to design and build, be scalable from small to large payloads, have full stability during construction, transport, and installation phases of the project, be fully commissioned at quayside, and incorporate the lessons learned from working with our operators on performance, marine systems design, operability, and maintenance.

When evaluating field development scenarios for a Dry-Tree solution the main drivers are 1) cost of contracting MODU’s, 2) type of reservoir (Recovery Factor) 3) type of well intervention, and 4) number of wells. Dry-Trees have been well proven in mature fields and are a technology with which operators feel comfortable. In addition, integration and commissioning at quayside, is safer and protected from the weather elements, and there is the ability to perform a wet tow of the completed Dry-Tree Unit (DTU) to the field which is preferred by operators to competitors’ more expensive and risky options that require integration and commissioning offshore.

The Dry-Tree Semi-submersible complements the FPSO product by enabling integrated solutions when dry-trees are needed.

SBM Offshore continually improves TLP and Semi-Sub solutions with state-of-the-art technological advances. Our OTC award-winning Drilling Riser Trip Saver™ is an innovative apparatus and method for drilling multiple subsea wells consecutively, which saves time, money and reduces risk by avoiding removal of the suspended drilling riser from the well bay. It uses a rail-mounted transport system, which relocates a suspended drilling riser with a drilling riser tensioner system and surface blowout preventer in-place. You can read more about this technology on page 14.

Definitions:

Semi-submersible

A floating unit, comprising of columns and pontoons. The columns support the deck while the pontoons interconnect the columns below the water surface. The open spacing in between the columns makes the unit more compliant with the waves. Station keeping for a semisubmersible is typically provided by a mooring line configuration – the preferred solution for long term station keeping - or by a dynamic positioning system.

Tension Leg Wellhead Platform (TLWP)

A floating production and or drilling platform where station keeping is provided by vertical tension elements called tendons. The tendon tension is provided by excess buoyancy of the hull. Subjected to wave, wind and current action, the platform moves laterally, but remains horizontal due to the parallel actions of the tendons. The vertical movement (heave) is eliminated and the facility is therefore suitable for surface completion of the wells.

SeaStar® - TLP developed by SBM Offshore’s Houston office, is the well proven example of a TLP, using a mono-column structure as opposed to multi-column (typically four). This TLP can accommodate wet or dry tree development up to payloads of 11,000 tonnes for deepwater developments.

FourStar™ TLP - TLP developed by SBM Offshore’s Houston office, a four-column TLP design that supports full deepwater drilling and/or production riser payloads exceeding 8,000 tonnes and can be scaled up to payloads of 40,000 tonnes The design allows for efficient quayside integration of topsides and hull systems and is self-stable for transport and installation with all equipment installed.
Extending the operating envelope of large mooring systems
The market demand for turnkey mooring systems is strong, particularly for large, complex turrets, often located in some of the world’s most severe offshore environments. These complex turrets present many technical challenges, and give us the opportunity to demonstrate our expertise as the world leader in mooring technology.

At the top end of the market, the required operating envelope of these complex mooring systems is continually being extended: deeper water, more severe weather conditions, larger vessels to be moored, higher throughputs, increased pressures and longer design lives. The introduction of a 10,000 year return period design case is also becoming a more common requirement, replacing the traditional lower return periods as the governing case for the design. Complexity of a turret is dependent upon many factors, but one simple indicator is the diameter of the turret chaintable, which is affected by both the mooring loads resulting from metocean conditions and vessel size plus the number of risers. The average diameter has effectively doubled over the last 20 years, and SBM has delivered turrets with diameters up to 25m.

A key component in these large turret designs is the bogie bearing system. This system is the interface between the geostationary turret and rotating vessel, and it allows the vessel to weathervane around the turret and adopt the position of least resistance to the prevailing weather. Our SBM’s bogie design was initially developed from in-house experience gained designing large crane bogie systems, and was first used on the Schiehallion FPSO in the severe environment of the Atlantic Margin. This system has now operated for 15 years, and the bogies have performed their function without incident.

The development and continued use of the bogie system is based on its clear advantages over a traditional roller bearing for large turrets:

1. All components are above water and inspectable
2. Individual bogie components can be replaced while the FPSO is operating
3. The individual units are standard components with a proven service history, and the number of bogies used is selected to match the loads that the system will experience

Manifold section of the Skarv turret
To further extend the use of the bogie system for extreme conditions, we have developed a variant of the internal turret design that features a set of ‘stoppers’ near the level of the vessel keel. In normal operation there is a gap between the stopper and the turret cylinder, and all the mooring loads are transferred through the bogie system. However in extreme conditions, the turret cylinder contacts with the stopper, and the stopper becomes the load path for these high mooring loads. Because the stoppers are simple and robust, and only occasionally experience any load, they do not need to be inspected, and the advantages of the bogie system are preserved. This design was first employed for the BP’s Skarv FPSO turret, and has since become a standard feature of our high capacity internal turrets.

In addition to increasing mooring loads on permanently moored systems, there has also been a steady increase in the load demand on disconnectable systems. To address this challenge, SBM has developed a high capacity connector able to lock a disconnectable buoy into an internal turret, and to be able to release the buoy under load in less than a second. Like the bogies, the connector is a generic device, and the number used will be matched to the load requirement. This generic component has a capacity of 900 tonnes per connector when locked, and can release the buoy under more than 600 tonnes. By combining a number of connectors in this manner, disconnectable systems can now be designed to both stay connected and then disconnect under high mooring loads. This opens the possibilities of using disconnectable systems in ice fields, and to withstand 100 year return period cyclonic conditions, whilst disconnecting to avoid the 10,000 year case which may otherwise govern the strength requirements of the mooring, hull and topsides structure.

As part of SBM’s commitment to staying at the leading edge of swivel design, an HV AC electrical swivel has also been qualified, winning an OTC Spotlight on Technology award in 2011 for this development.

Many of the developments aimed at large turrets, and the lessons learnt executing these projects, have also brought benefits to the design of mid-scale mooring systems. For example, diverless chain connects such as the ARCA (designed to allow change-out of the articulation for systems with long design lives), or the In-Line Mooring Connector (the ILMC, developed to move the tensioning means from the mooring system to an installation vessel), both bring benefits in safety, and result in a more compact turret design. Research and development on swivel seal performance also brings benefits to swivels on all of SBM Offshore’s weathervaning systems.

We are committed to continuing our development programme for moorings, and in developing world class technology that will satisfy evolving demands. By working closely with clients to ensure an understanding of their needs, the company will continue to push the boundaries of mooring technology, and to deliver the mooring systems of the future.
The SBM laboratory has always been a key factor in our ability to stay at the forefront of mooring technology. Being able to prototype and qualify our products in-house gives us a major advantage over our competition, and the work of the lab has been fundamental in the successful development of our high pressure fluid swivels, MAG anchors, HVAC swivel, cryogenic swivels and LNG offloading hoses.

The lab was originally established in St Laurent du Var in France in 1989 after the acquisition of test rigs from EMH. In 2004 it relocated nearby to the present larger premises in Carros, France, which provides a total area of 1100m², including an indoor hall of 600m² which houses most of the complex test rigs. Monitoring tools such as videextensometers, photogrammetry equipment, and high speed and infra-red cameras are available as part of the lab’s standard equipment, and partnerships with external organisations such as the University of Nice also gives us access to tomography, goniometrics and other advanced monitoring and analytical techniques.
The sole intention of this brochure is to share general information.

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